Microchip Capillary Electrophoresis for In-Situ Water Analysis, Phase II

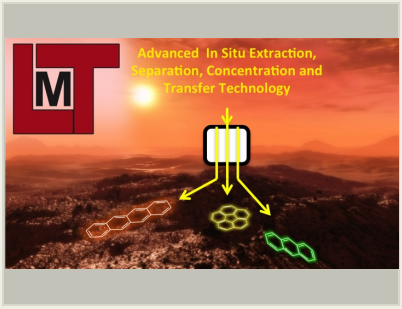
Completed Technology Project (2016 - 2021)

Project Introduction

In this Small Business Innovation Research (SBIR) project, Leiden Measurement Technology, LLC (LMT) will develop a portable microfluidic analysis instrument for measurement of inorganic ions present in potable water supplies, thermal control system cooling water, and human waste water. A primary goal of the Phase I effort was to identify and demonstrate the most viable development path to advance current state-of-the-art NASA microfluidic analytical instrument technology into a user-friendly, compact, and automated instrument platform for use on the International Space Station (ISS). In this SBIR Phase II effort, LMT will advance current state-of-the-art technologies by developing a Microchip Capillary Electrophoresis (MCE) system with Capacitively-Coupled Contactless Detection (C4D) for the rapid separation, detection and quantification of inorganic ions specified in NASA Spacecraft Water Exposure Guidelines (SWEG). The specific objectives of this Phase I R&D effort are: 1) Development and fabrication of Phase II Microfluidic Chips with Embedded C4D Electrodes for Water Quality Analysis on the International Space Station; 2) Development and fabrication of a Phase II Lock-In-Measurement C4D; 3) Development and fabrication of Phase II MCE Microcontroller and Power Breakout Board; 4) Development of and fabrication of a Phase II MCE High Voltage Board; 5) Verification and validation and end-to-end instrument integration

Anticipated Benefits

Our SBIR developed automated analysis systems will address a number of essential NASA needs and requirements. A primary target application is efficient separation, identification and quantification of ion organic both potable and non-potable water supplies. This directly addresses the NASA Human Exploration and Operations Directorate Goals by providing technology to enable the safe and extended use of the International Space Station. The proposed technology is also highly relevant the needs of Human-Robotic Space Exploration and Space Life & Physical Science Research Applications. The instrument will prove improved and enhanced technology to overcome analytical constraints that may be encountered in future Science Exploration missions. The proposed technology is also applicable to contamination control studies and other NASA Planetary Protection needs.Chemical separation and analysis of inorganic ions from aqueous matrices is a fundamental need in many industries including: pharmaceutical, chemical, food and beverage, environmental, and medical, and biotech. Our SBIR developed compact automated instrument system will be particularly suited for the measurement of trace levels of inorganic contaminates in drinking water supplies, the need for which reaches globally. The innovative power of our system stems from robustness of the detection system, which greatly improves portability allowing use in remote regions across the globe. This detection approach is packed in to a user versatile friendly system that can be used to automate routine sample processing or serve as the basis of a high fidelity research



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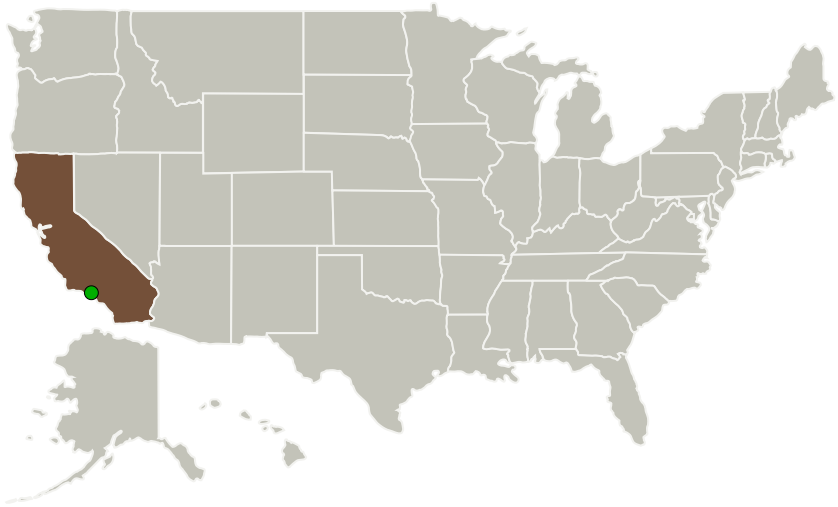
instrument with the ability to couple detection systems (e.g., Laser Induced Fluorescence and C4D) in the same unit. In this configuration, the instrument provides the capability for end-to-end organic and inorganic chemical analysis of complex matrices. As an automated system for medical applications, our instrument will provide point-of-use technology for the identification and quantification of inorganics (and organics) in biological fluids with lab-on-a-chip analysis. The instrument is well suited for numerous potential commercial applications where separation and of inorganic species is required including: soil analysis, water analysis, and diagnostics.

Primary U.S. Work Locations and Key Partners



Organizations Performing Work	Role	Type	Location
Leiden Measurement Technology, LLC	Lead Organization	Industry	Sunnyvale, California
Jet Propulsion Laboratory(JPL)	Supporting Organization	NASA Center	Pasadena, California

Primary U.S. Work Locations
California

Organizational Responsibility

Responsible Mission Directorate:

Space Technology Mission Directorate (STMD)

Lead Organization:

Leiden Measurement Technology, LLC

Responsible Program:

Small Business Innovation Research/Small Business Tech Transfer

Project Management

Program Director:

Jason L Kessler

Program Manager:

Carlos Torrez

Project Managers:

Robert A Jones
Carol R Lewis

Principal Investigator:

Nathan E Bramall

Co-Investigator:

Nathan Bramall

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Project Transitions

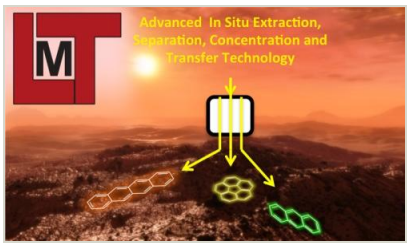
April 2016: Project Start

March 2021: Closed out

Closeout Documentation:

- Final Summary Chart PDF*(https://techport.nasa.gov/file/139715)*

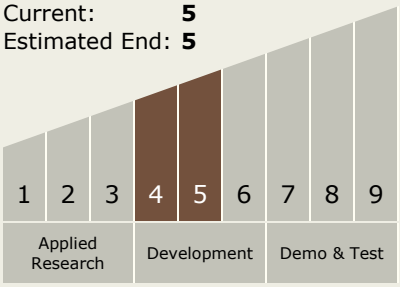
Images



Briefing Chart Image
Microchip Capillary Electrophoresis for In Situ Water Analysis, Phase II *(https://techport.nasa.gov/image/132262)*

Technology Maturity (TRL)

Start: **4**
Current: **5**
Estimated End: **5**



Target Destinations

The Sun, Earth, The Moon, Mars, Others Inside the Solar System, Outside the Solar System